Dual arm manipulation and whole body control with the humanoid robot Romeo by visual servoing

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Abstract

The purpose of this presentation is to show two visual-servoing applications on the humanoid robot Romeo: dual arm manipulation and preliminary results on the implementation of a whole body control framework.

In the control scheme for the dual arm manipulation, we consider the case of two arms creating a closed kinematic chain and holding a rigid body object with fixed grasp handles. For this kind of task, common solutions are hybrid force/position control and impedance control. However, if the arms are not equipped with any force sensors, as in our case, an alternative solution is needed. The aim here is to control both arms using a Pose-Based Visual Servoing and a master/slave approach, in order to apply any translation and rotation to the grabbed object, just by knowing its pose with respect to the camera. To validate our approach, we developed an augmented reality demonstration. The two arms, 14 joints in total, are holding a tray from two handles as in Figure 1. A known picture is placed on the tray, it is detected automatically and then tracked using the template tracker in ViSP [1]. Furthermore, this algorithm computes the 6D pose of the picture with respect to the camera. A virtual maze is added in augmented reality on the top of the tray and its pose is directly linked with the pose of the picture. The aim of the game is to roll the virtual ball from its actual position to the end of the maze[1]. The main software used to develop this framework are the Aldebaran SDK C++, ViSP, ViSPNaoqi, Panda3D[2], Metapod[3] and OpenCV. The source code of this demonstration is available online on GitHub[4].

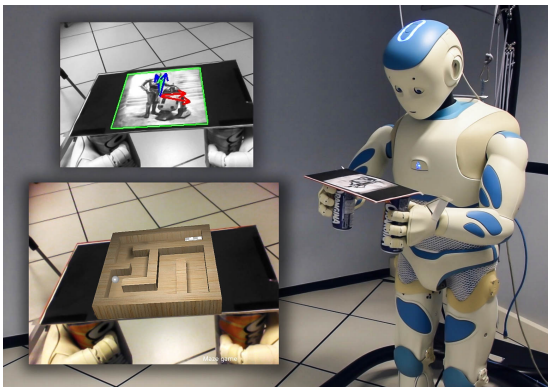

Figure 1: Romeo solves a ball-in-maze game in augmented reality using two hands. Only vision is used to control both arms.

The whole body control framework consists in adapting on Romeo, the multi-objective quadratic program controller presented in [2], which was originally implemented on the HRP-2 robot. Our preliminary results show that visual servoing tasks can be achieved along with common tasks, such as maintaining a posture, balancing and avoiding joint limits. For this purpose, an Image-Based Visual Servoing is used to track the hand with the gaze. Simultaneously, a Position-Based Visual Servoing is used to move the hand from its current position to a desired one, in order to accomplish manipulation tasks, such as grasping. This approach leads to a larger workspace and enables the performance of more complex motions than our previous solution [3].

Acknowledgement

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References

[1] E. Marchand, F. Spindler, F. Chaumette. "ViSP for visual servoing: a generic software platform with a wide class of robot control skills", IEEE Robotics and Automation Magazine, Special issue on "Software Packages for Vision-Based Control of Motion", 12(4):40-52, December 2005, http://team.inria.fr/lagadic/visp

[2] J. Vaillant, A. Kheddar, H. Audren, F. Keith, S. Brossette, A. Escande, K. Bouyarmane, K. Kaneko, M. Morisawa, P. Gergondet, E. Yoshida, S. Kajita, & F. Kanehiro. "Multi-contact vertical ladder climbing with an HRP-2 humanoid", Autonomous Robots, 2016, 40, 561-580

[3] G. Claudio, F. Spindler, F. Chaumette. "Grasping by Romeo with visual servoing", Journées Nationales de la Robotique Humanoïde (JNRH), Jun 2015, Nantes, France, <hal-01159882>

[1] Video dual arm manipulation: https://youtu.be/-wIzJ2Ckifg
[2] https://www.panda3d.org/
[3] https://github.com/laas/metapod
[4] https://github.com/lagadic/